

# AFSCET

## Res-Systemica

Revue Française de Systémique  
Fondée par Evelyne Andreewsky

Volume 21, printemps 2021

Examples of Innovation and Application  
of Systems Sciences in France

Res-Systemica, volume 21, article 08

A Multidimensional and Harmonized Systemic Integrative  
Approach For Managing Complex Societal Challenges

Jacques de Gerlache & Patrick Corsi

16 pages

contribution reçue le 06 mai 2021



Creative Commons

# A Multidimensional and Harmonized Systemic Integrative Approach For Managing Complex Societal Challenges

Jacques de Gerlache<sup>1</sup> & Patrick Corsi<sup>2</sup> \*

<sup>1</sup> Centre National des Experts en Environnement de l'Industrie Chimique (CNEEIC), 92800 Puteaux, France; Institut Supérieur Paul Lambin, Haute Ecole Léonard de Vinci, 1200 Bruxelles, Belgium, Club of Rome EU-Chapter, The *GreenFacts Initiative*, Brussels. Belgium [jacquesdegerlache@gmail.com](mailto:jacquesdegerlache@gmail.com) <http://www.cneeic.org>

<sup>2</sup> Cayak-Innov SAS founding partner, Paris; Associate Practitioner Mines Paris Tech, Paris, France, Club of Rome EU-Chapter, [patrick.corsi@cayak-innov.com](mailto:patrick.corsi@cayak-innov.com) <http://www.cayak-innov.com>

\* Correspondence: [jacquesdegerlache@gmail.com](mailto:jacquesdegerlache@gmail.com)

**Abstract:** The quest of this paper is to generate a generic systemic mould akin to evolve the management of all types of complex challenges faced by society. First, the original management objectives are cast into the progressive formulation of a cohesive problématique and confronted to the key elements of its dominant design. Then, the irreducible interactions between the dimensions - environmental & social, economical & financial, ethical & cultural - are integrated. A preparatory innovative design process based on the C-K Concepts-Knowledge theory from Mines ParisTech is conducted beforehand until landing an implementable portfolio of actionable projects in systemic perspective. The process entails a) Analyzing the surrounding core elements of the current dominant design of society and economy and eliciting and reformulating the relevant deep knowledge associated; b) Defining powerful and contrasted directional blueprints; c) Coining pivotal concepts impending systemic endeavors; d) Expanding conceptually the latter, leading to advanced conceptual formulations; e) Finally, structuring a resulting harmonized portfolio of key actions. The strategic axes found out are articulated through a gyroscopic compass model - a strategic gateway towards futures-oriented take-up plans, roadmaps and governance for experts, politicians, decision-makers, policy makers and other socio-economic players. This makes possible to harmonize and operationally conduct a combined approach for all involved stakeholders inclusive of their proper objectives, constraints, and indicators.

**Keywords:** Systemic dimension - Multidimensionality - Sustainability - C-K theory - Harmonization methodology.

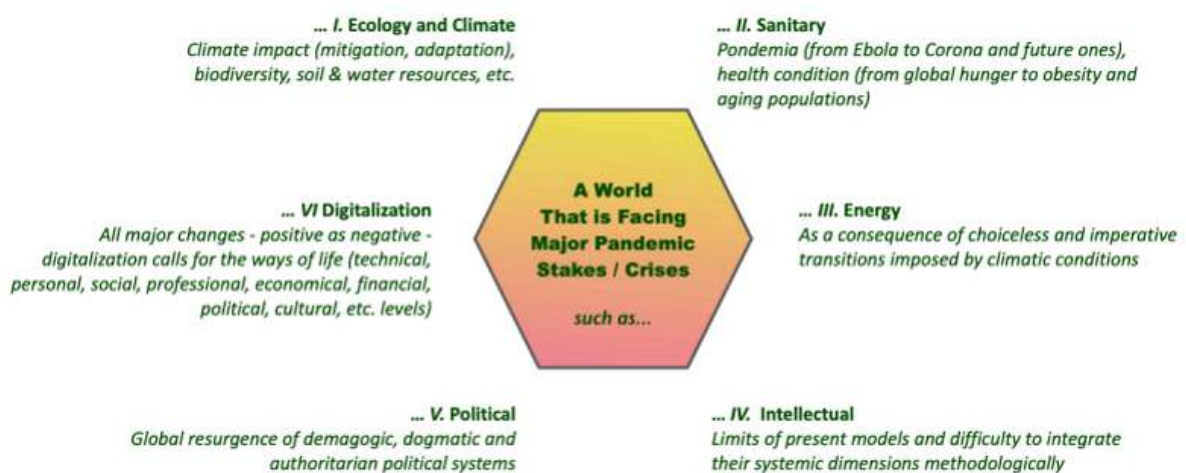
oooooooooooooooo

## 1. Orienting the work

The objective of the proposed work is to generate a generic systemic mould akin to evolve the management of the irreducible dimensions of the complex challenges faced by our societies, these being ecological or economical, sanitary or social, financial or political, cultural or ethical. This work made clear that multiple constraints and limits are deeply interwoven in a "continuum" in which the dimensions are inextricably intertwined. Hence

the need to integrate into this continuum the constraints arising from the interactions existing between the different issues at stake in a given situation.

Integrating a rigorous systemic approach with the classical analytic approach of these issues appears to be not only an absolute but also an urgent necessity. While such approach was developed theoretically [1-4] for several decades and taught by various institutions [5-7] and specialized consultancies [8-10] and applied in some management practices [11-13], its practice remains far from generalized. It is the only integrative way to disentangle the complex issues raised in the management of our post-modern societies in a timely and useful manner (Figure 1). The systemic integration of the associated field concepts, challenges, resources and stakeholders is essential to restore practices preserving their respective assets allowing more sustainable futures.



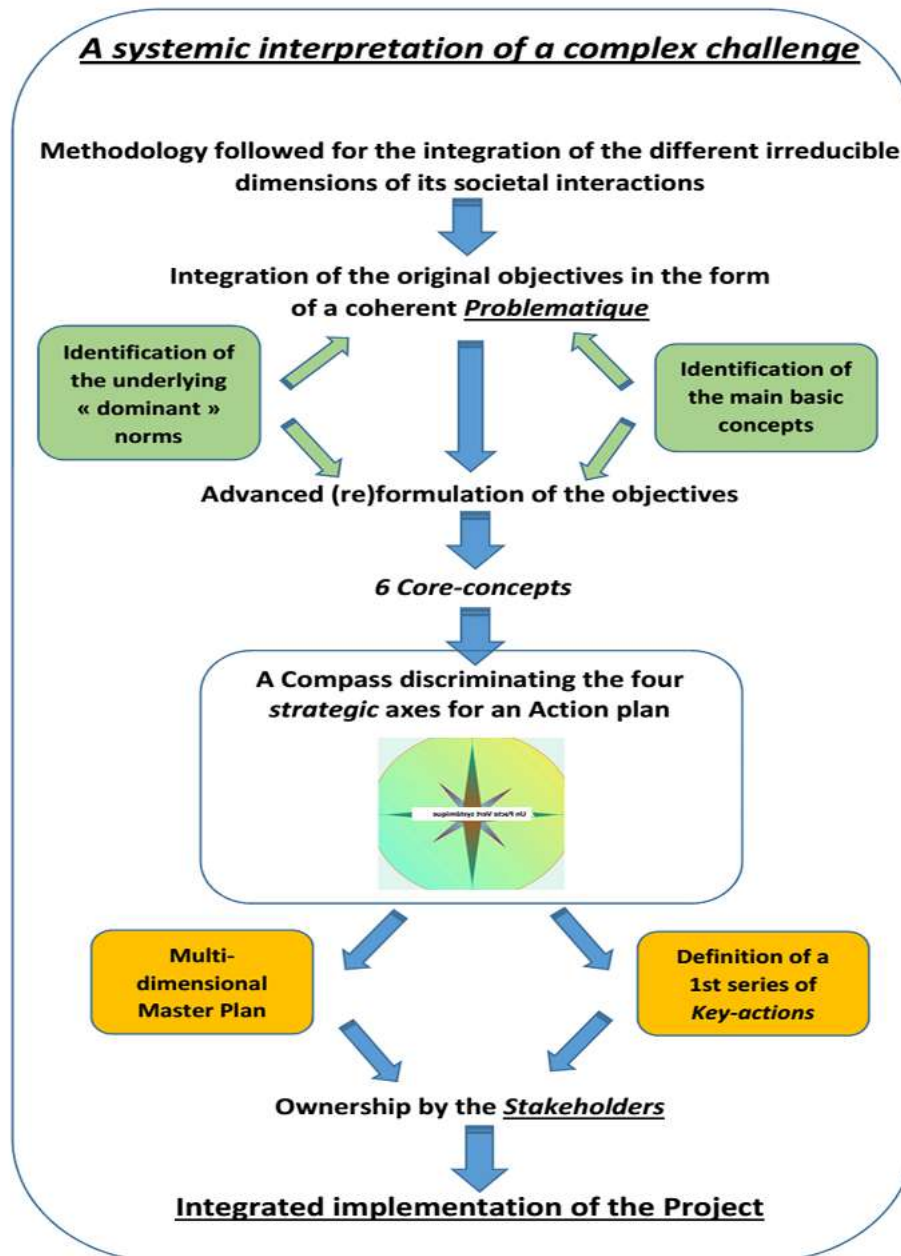
**Figure 1.** Six interacting constraints categories on the present evolution of the systems managing humanity.

## 2. Preparatory Materials and Methods

A preparatory design process (DKCP) based on the *C-K Concepts-Knowledge* theory from Mines ParisTech<sup>1</sup> was conducted beforehand until landing an array of coherent objectives and targets mobilizable into a portfolio of actionable projects in a systemic perspective.

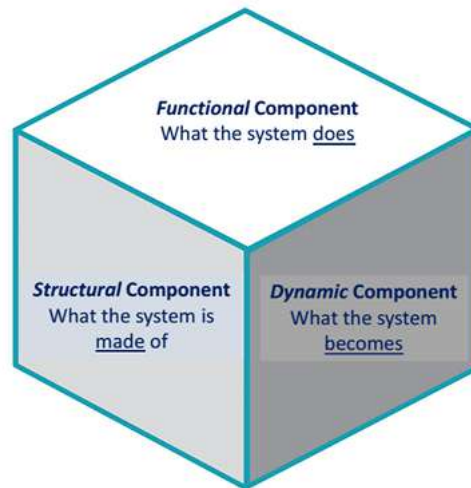
The coherent implementation of the portfolio of actionable projects in a systemic perspective needs specific management attention. Hence, the process integrates a representation based on an “*orchestral matrix*” structure which allows to harmonize the identified project actions. A symbiotic integration of their objectives with stakeholders’ expectations becomes possible at the light of the main constraints. Figure 2 presents the global scheme of the method followed.

<sup>1</sup> The DKCP design innovation method is based on the well-known C-K theory developed by the *Centre de Gestion Scientifique* at Mines ParisTech over the last decades. However, an account of the detailed process is not the subject of this paper and the interested reader may refer to the original report « *A Reinterpretation of the European Green Deal* » mentioned and referenced in Section 3 as well as the additional references of this paper [14-16].



**Figure 2.** The global process applied to integrate a systemic dimension in the analysis and management of complex and irreducible challenges.

First, the given objectives were progressively (re-)formulated into a cohesive problématique and confronted to the key elements of its dominant design. Then, the irreducible interactions between the three design parameters components of its various interconnected dimensions were integrated: environmental & social, economical & financial, cultural & ethical (Figure 3).



**Figure 3.** The three design parameters components of a complex system.  
*Adapted from Donnadieu & Karski, 2002 [17]*

### 3. Getting Actionable Results

This section sheds light on a number of preparatory steps leading to actionable systemic renderings.

#### 3.1. The global reformulation of the project and its associated designs and dimensions

The process entails five successive steps:

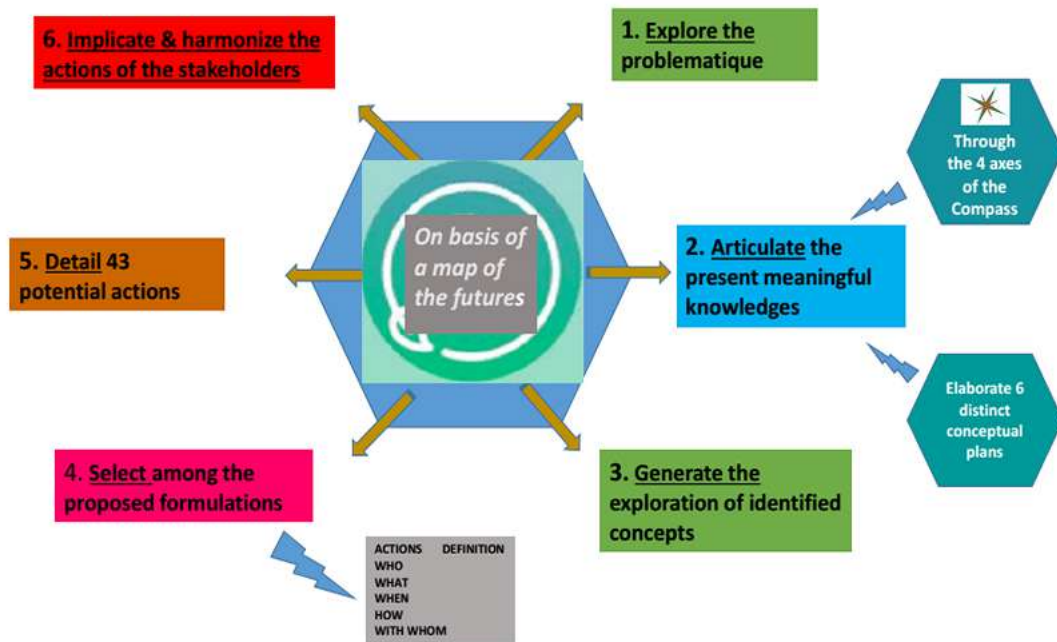
- a) *Analyzing* the surrounding core elements of the current dominant designs of society in their respective domains (ecology, economy, etc.), eliciting and reformulating the relevant deep knowledge associated.
- b) *Defining* powerful and contrasted directional blueprints.
- c) *Coining* pivotal concepts impending systemic endeavors.
- d) *Expanding* conceptually the latter, leading to advanced formulations and articulating them through a gyroscopic compass model;
- e) Finally, *structuring* a resulting orchestrated strategy combining key challenges, constraints and stakeholders (*politicians, decision-makers, policy makers and other socio-economic players*), resulting into an harmonized programme of key actions towards futures-oriented take-up plans including roadmaps indicators and governance.

##### 3.1.1. Analysis and reformulating the dominant designs

This process is started by basing the plot in the following terms:

- *Given 1*: the original reference document(s) submitted to the process: reports, project description, etc.;
- *Given 2*: a set of general and specific explicit background terms about a variety of socio- economic domains underpinning the document(s). These were found to be instrumental in populating the reference knowledge base;
- *Do first*: elicit hidden hypotheses and, if applicable, acquire and tag the knowledge holes which may appear upon a priori analysis.

- **Do then:** generate a version of the document that is:
  - a) *Coherent*, meaning the outcome should become a systemic and harmonized exposition of the plan, such that it weaves the impending socio-economic and ecological dimensions together.
  - b) *Coherently implementable* by respective stakeholders. Figure 4 recaps the whole design activity as inspired from an underpinning standard DKCP process.

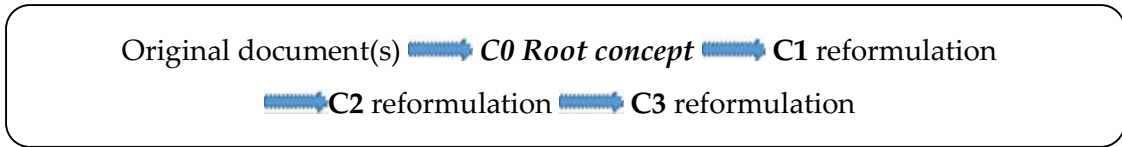


**Figure 4.** The six pivotal axes emerging from the systemic reformulation of the blueprint concepts of a societal challenge.

The ways to structure socio-economic knowledge within better ecological contexts impacts the nature of the resulting conceptual expansions. It is even a fundamental knowledge management question with interesting research aspects [18].

### 3.1.2. Coining pivotal concepts into advanced conceptual formulations

C-K theory finds a seek expansive power through elaborating a fair genericity capacity - a mostly non algorithmic human practice. To start-off, a first root conceptual formulation is directly obtained from the analysis of the early reference document(s). This initial expression often underpins a highly complex and intricate number of conditions. Their various dimensions need be first disentangled by expressing these into a simpler (simplexified) conceptual form. This reformulation dynamically includes and combines the space and time dimensions with societies' structural patterns. At this point, the objectives of the project rationale get better clarified. By specifying further the wished properties for the initial problématique, another reformulation can yet be worked out for use by any subsequent work (Figure 5).



**Figure 5.** The multistep process of the conceptual reformulation of a root concept.

Let's follow the process with the *Systemic Reinterpretation of the European Green Deal* case example [19, 20]. The shortest expression of the start-off C0 formulation « *We want to reconcile our economy with our planet, and make it work for our people* » underpins a highly complex and intricate number of conditions. Let's disentangle them (P1 denotes Property 1 and relates to the object under investigation X: « The EU Green Deal »):

**C1 - The (object X = The European Green Deal) proposal is adjunct with properties:**

- **P1(X): Launching a new growth strategy for the EU.**
- **P2(X): Supporting the transition of the EU to a fair and prosperous society that:**
  - **responds to the challenges posed by climate change and environmental degradation,**
  - **improves the quality of life of current and future generations.**

C01 underpins various dimensions (Stakeholders, Sustainability in socio-eco/no/lo/mic ways, Constraints (sanitary, economic and/or social crisis)). A fundamental property required for economies is to comply with systemic circularity, meant to ensuring sustainability by preserving the reference capital. In this context, the notion of Capital is taken in its most general assets definition, encompassing economical and financial assets, but also the ecological, social, and ethical ones. We can reformulate the root concept as C1.

**C2 - « A systemic Green Deal:**

- **where the global and harmonized stakeholders seek to ensure:**
  - **socio-eco/lo/no/mic sustainability**
    - **by including resources, processes, and practices circularity**
- **to preserve:**
  - **planetary capital**
  - **human societies**
  - **activities, incl. economies**
- **trans-generational welfare »**

This formulation dynamically includes and combines the space and time dimensions with societies structural patterns. At this point, the *Sustainability* rationale gets understood as

using the *Planet* revenues, but not its *Capital*. An amplified reformulation can then be obtained to be used for the later conceptual expansions.

### **C3 - « A systemic and global Green Deal:**

- 1. Encompassing, involving, and harmonizing all stakeholders,**
- 2. Aiming to seek the means and tools mandatory for ensuring welfare:**
  - a. At the global and sustainable « socio-eco/lo/no/mic » level:**
    - i. By limiting the use of natural resources to the yields of the planetary capital,**
    - ii. Through adoption of appropriate processes and practices (a.o. for the optimisation of the circularity of resources uses),**
    - iii. Taking into account the intertwined actual constraints (a.o. climate, sanitary, food, social, economical and political crises, etc.),**
  - b. For the balanced evolution (i.a. repairing/restoration, homeostatic preservation and innovative improvement) of:**
    - i. Planetary capital,**
    - ii. The well-being of human societies,**
    - iii. The underpinning economic activity,**
  - c. For trans-generational and symbiotic societies and planet.**
- 2. Within a democratic governance context. »**

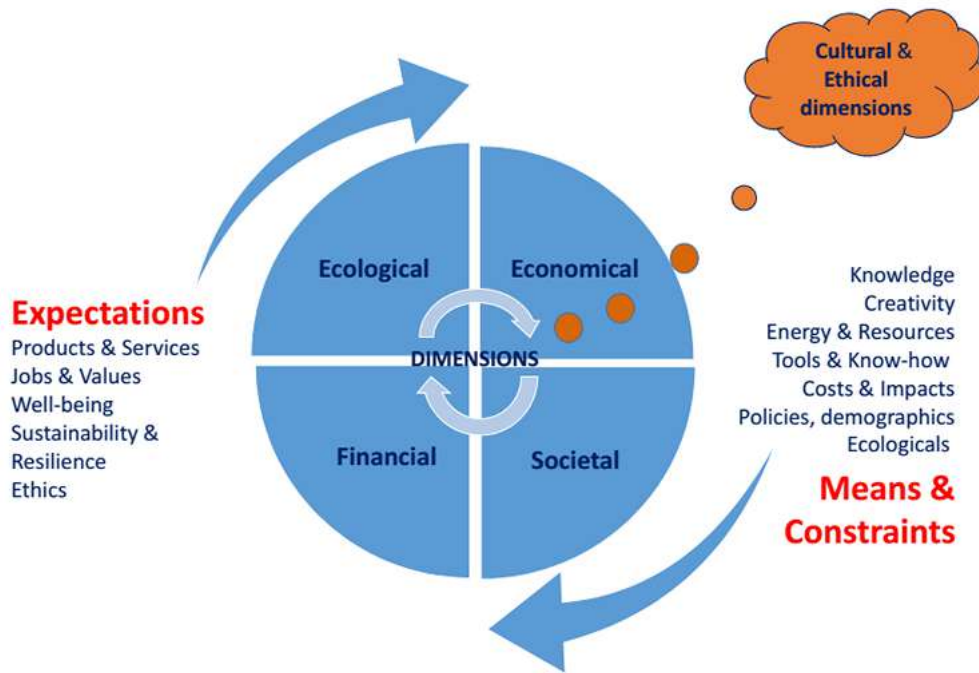
Often, the lack of commons in each dimension of the project leaves less room for their easy transversal implementation. By coring on the current dominant designs surrounding the problématique, contrasted concepts can be forged enabling the definition of powerful directional blueprints - pivotal concepts for impending future systemic endeavors, each partially covering the conceptual reformulations above. A further synthetic effort is then made towards obtaining a higher degree of genericity. Getting generic conceptual forms as feasible bears indeed high methodological value for two reasons:

- *it helps to decontextualize propositions* from their inherited dominant design basis,
- *it projects the investigation into more, yet uncharacterized directions*, thus opting for maximizing the expansive potential in innovative ways.

### **3.1.3. Expanding concepts into advanced formulations articulated through a gyroscopic compass model**

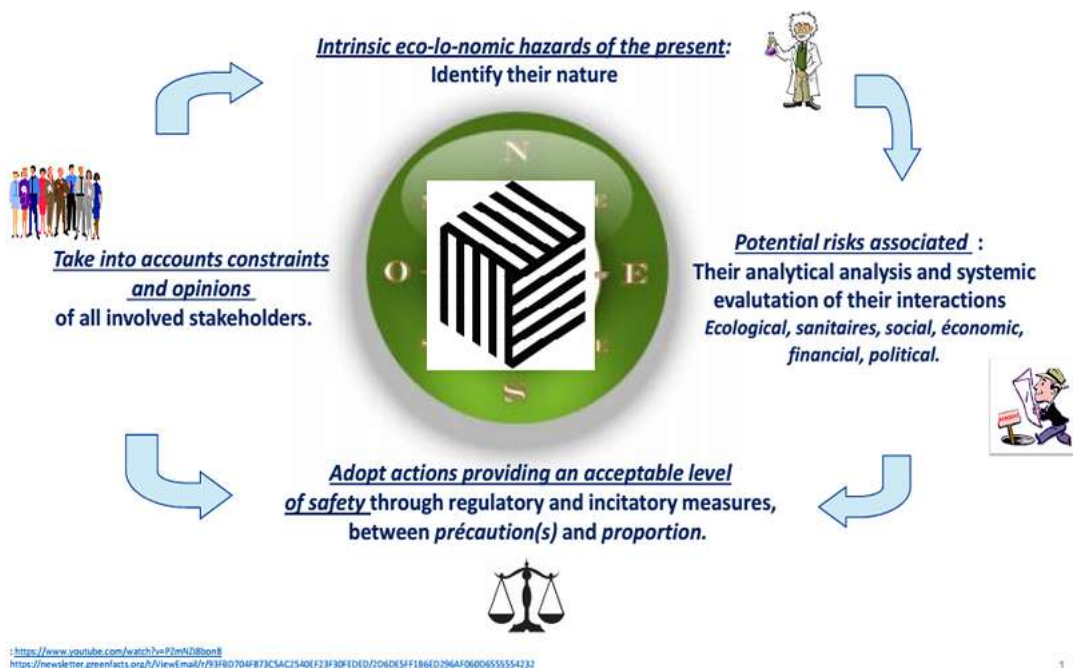
A full integration of the systemic interpretation and reformulation of the various concepts involved in the problématique allows to conceive a really operational and more resilient management of its complex and irreducible dimensions (Figure 6).





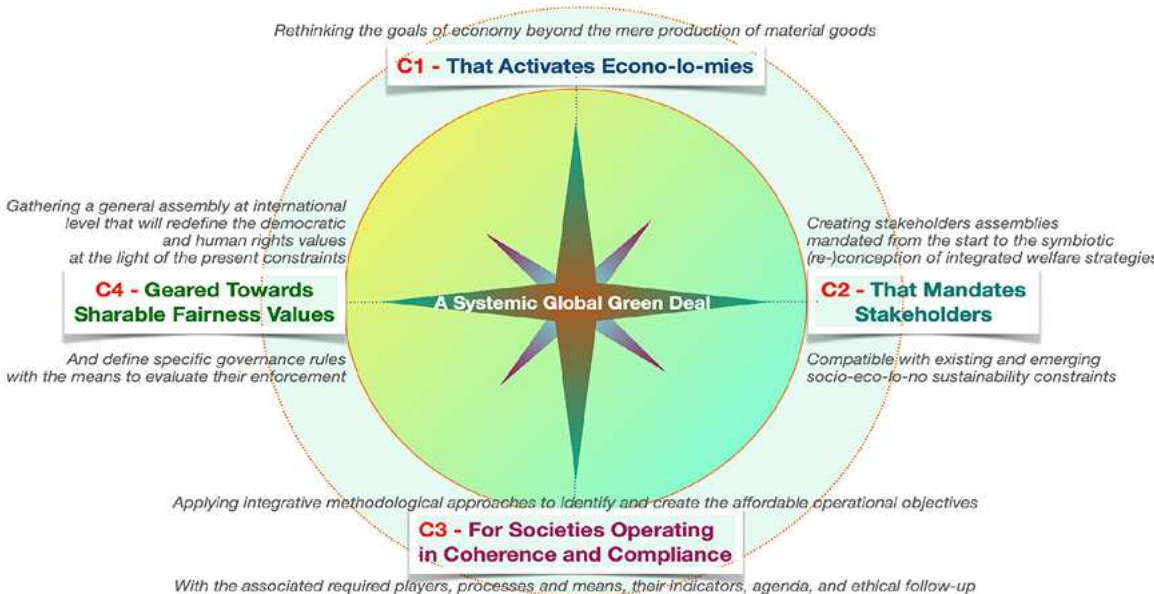
**Figure 6.** The dynamics of a systemic integration of the various dimensions involved in complex and irreducible societal challenges.

To this end, the expanded concepts pruned in a number of implementable findings are aggregated into an integrative representation method involving all stakeholders. The 6 pivotal axes of Figure 4 are integrated into the four poles of a *Game Changer Compass* which distinguishes for each challenge, the hazards and constraints, the risks and opportunities, the subsequent potential action plans and the involvement of all stakeholders (Figure 7).



**Figure 7.** Building a *Game Changer Compass* to clarify an operational strategy without losing the North.

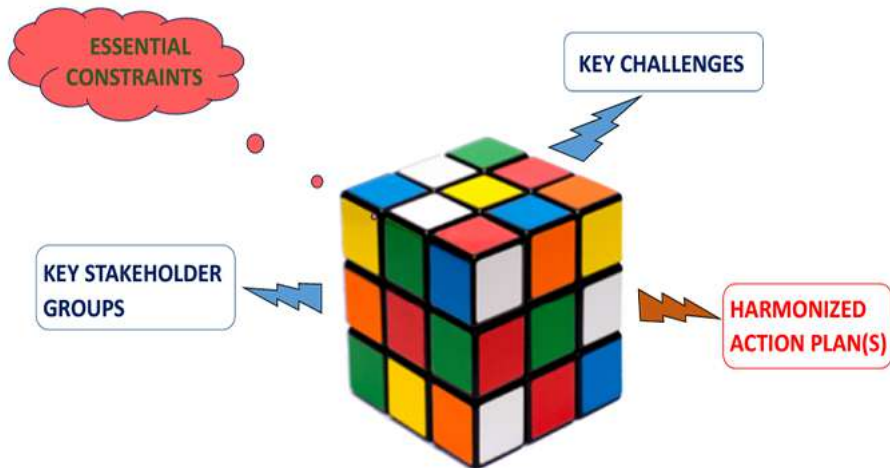
An example of such a *Game Changer Compass* for an operational strategy is given in Figure 8 of a *Systemic reinterpretation of the Green Deal For Europe* [19, 20]



**Figure 8.** Example of a *Game Changer Compass* (GCC) obtained from the process when applied to the systemic (re)interpretation of the *Green Deal for Europe* of the European Commission [19, 20].

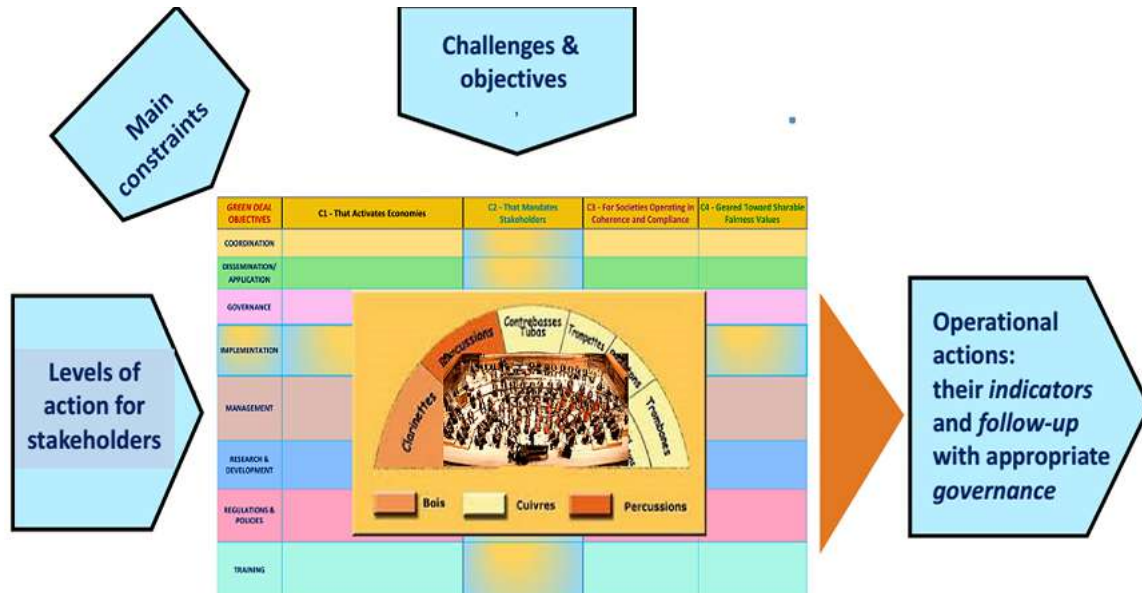
**4. Structuring a resulting orchestrated strategy into an harmonized programme of key actions**

This step is organized towards futures-oriented operational action plans combining these identified key challenges, their constraints and stakeholders (*politicians, decision-makers, policy makers and other socio-eco-lo-nomic players*) in actions plans that will include means, roadmaps, indicators and governance rules (Figure 9).



**Figure 9.** Building harmonized actions plans by combining key challenges and stakeholders views at the light of the global constraints.

In practice, a matrix-based approach is proposed which is grouping the identified strategic challenges intersected by the stakeholders expectations at the light of the global constraints. (Figure 10). This “orchestral matrix” allow stakeholders to analyze, build and materialize stepwise, coherent & sustainable harmonized strategic plans.



**Figure 10.** An “orchestral matrix” as a mean to harmonize symbiotically the challenges and constraints of all stakeholders in a truly coherent and operational action plan.

In the operational implementation of such integrated strategy, instead of being “face to face”, the stakeholders are gathered around the above matrix, which noticeably allows them:

1. To *jointly integrate* the three constituent dimensions of the orchestral matrix;
2. To *examine analytically* their structural, functional and temporal interactions;
3. To *harmonize*, in the musical and philharmonic sense, the points of view their implications;
4. To *agree on* coherent action programs integrated with their protocols, steps, monitoring indicators, follow-up and strict uniformed governance rules ;
5. To *coordinate* their harmonious implementation and *communicate* with all the stakeholders concerned about it in a pedagogical way.

Based on previous experiences [21,22], it is practically commendable to limit the number of lines and columns of the matrix to five in order to keep it mentally manageable and facilitate the exchanges and adjustments. An instance of a simplified matrix is given in Table 1 showing the case of managing energy transitions in their global and intrinsically irreducible complexity.

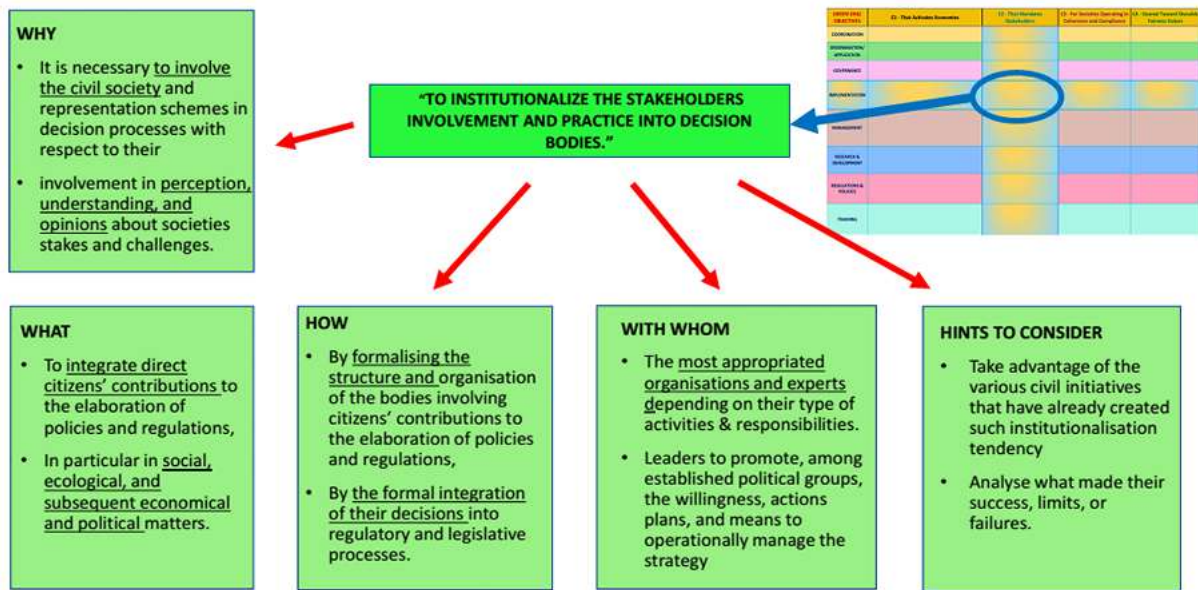
	Energy Ressources	Energy transport & storage	Energy uses	Energy savings
Business & financial actors	Develop energy ressources adapted to industrial needs and economically sustainable	Develop combined transport & storage (T&S) capacities adapted to economic requirments	Product & offer the energy necessary for industrial activities	Promote processes and products that reduce the energy needs for their production
Political & regulatory Actors	Impose a.o. via taxation systems choices regadrng the nature of energy rressources used	Define needs & rules regarding etworks management systems ensuring fair distribution of the various forms of energy	Propose and impose the rules to manage sustainable energy uses	Define clear objectives & dead lines regarding the level of energy saving to be reached
Citizens & their representa-tives incl. NGOs	Ensure the availability of sustainable energy rressources adapted to local geophysical constraints	Favor local energy rressources & develop T & S respecting citizen expectations and needs	Debate about the societal priorities & choices regarding energy uses	Develop processes leading to significant reductions of individual energy consumption at all levels
Soci(et)al Actors : academics, cultural, ...	Identify and promote the most sustainable & efficient renewable mix of rressources adapted to each local situation	Take into account innovation, societal & environmental factors to improve efficiency of T&S	Make citizens and their representatives responsible of the best integrated management of their sustainable energy uses	Mobilise societal actors to create paradigm shifts adapted to the new energy rressources

**Table 1.** Example of simplified symbiotic matrix: the management of energy transition(s).

Once an initial matrix is elaborated, it becomes possible to re-examine collectively each cell to identify weaknesses, strengths, contradictions, disagreements and oppositions by analyzing their constituents:

- *Why*: the rationale for considering;
- *What*: actual contents to watch, develop, or implement;
- *How*: which approach seems to be appropriate at this stage;
- *With whom*: what kind of cooperation or collaboration is relevant to perform the field action(s);
- Plus *Hints*: any comment or advisable suggestion, based on experience or else.

This, in order to create and manage synergies in the necessary global perspective. A simplified example of the way to initiate the process is given in Table 2.



**Table 2.** The analytical phase of the orchestral matrix process within a systemic integrative approach for managing complex societal challenges.

By making such projects constructively possible, this integrative approach may contribute to provide more chance for these to become, when clustered together, an organic reality of our times. And for some critical issues, like the climate, biodiversity, food, sanitary and migration challenges, they now become tractable.

## 5. Wrapping an experiential learning from conducting the process

- Piloting a multidimensional approach for systemic rendering, faces a number of difficulties of different natures.
  - The complexity of the case at hand** requires careful attention. Given that the juxtaposition of many relevant domains of expertise sprawls a gigantic knowledge territory caution should be taken to limit the case to the original project frame, usually itself a multi-experts synthesis.
  - External checks and revisions** of the process before the orchestral matrix stage itself are possible by having an external reviewer at process mid-point with interested and competent parties even if communicate about what is going on during the elaboration of the first phases may complicate the process.
  - Integrating, rather than opposing**, systemic rendering to standard project management is a clear requirement that is not often made plain. A resulting efficiency needs to be established.
  - The work should lead to making **feasible implementations** and a special effort was made to describe the resulting Actions with today's common fields terminology.

At this stage, the design process in fine may lead to a harmonized portfolio of key actions, being structurally coordinated through the 4 strategic axes forming the *Game Change Compass*. Examples of different types of field Actions identified in the process of the systemic (re)interpretation of the *EU Green Deal* mentioned earlier is presented in Table 3.

GREEN DEAL OBJECTIVES	C1 - That Activates Economies	C2 - That Mandates Stakeholders	C3 - For Societies Operating in Coherence and Compliance	C4 - Geared Toward Sharable Fairness Values
COORDINATION	C13 2 - to evolve demand towards qualitative rather than quantitative growth C13 3 - to raise awareness on the virtual discrepancy between finance and real economy and point to resolution axes C13 4 - to restore more direct links between the entrepreneur and the investor	nb. actions C13 2, C13 3, C13 4 are promoted by stakeholders.		
DISSEMINATION/ APPLICATION	C11 3 - to formalise the shift from goods-based to welfare economy	nb. action C1 13 is adapted by stakeholders.	C33 5 - to disseminate the adopted practices, train the relevant players to make them used, and provide financial incentives	C43 1 - to disseminate the new formulation of the democratic and human rights values and their enforcement (includes actions c42 1 and c42 2)
GOVERNANCE	C13 1 - ensuring that the activity considered does not affect the planet capital	C22 1 - to institutionalize the stakeholders involvement and practice into decision bodies		C42 1 - to redefine democratic and human right values at the light of the present constraints and realities
IMPLEMENTATION	C12 5 - to design and implement circular economy models C13 1 - ensuring that the activity considered does not affect the planet capital	C22 2 - to formalise stakeholders' contributions and practices for integration into decision-making processes C23 1 - to structure the stakeholders' competencies, experience and contributions to decision-making processes C23 2 - to structure and develop guidelines for stakeholders' operational management in decisionmaking processes	C31 3 - to quantify the available yields from the planetary capital expressed with adapted indicators	
MANAGEMENT	C12 3 - to identify and implement the necessary redundancy and precaution means into practices C12 6 - to manage circular economy processes C12 7 - practical methods, techniques, and measures for balancing efficiency and resilience in concrete projects	nb. action C12 6 is implicating stakeholders.	C31 3 - to make apply operating instructions in conformance with policies and regulations C32 1 - to develop creative indicators, processes, and tools adapted to the requirements of the new sustainable welfare objectives and regulations C32 2 - to define application conditions for ensuring feasible projects C33 3 - to apply the ways to optimize the use of available yields within their limits	
RESEARCH & DEVELOPMENT	C12 1 - to define the limits of renewable revenues c12 2 - to study the various ways of ecodesign Optimization	C24 1 - to design common welfare futures C25 1 - to research future models for extending personal welfare by breaking conventional mental paradigms C26 1 - to research futures commons and formally integrate them into current practices	C32 2 - to research the ways to optimize the use of available yields within their limits	C41 1 - take stock of and report on the present expression of democratic and human rights values as shared across the world today C42 1 - to redefine democratic and human right values at the light of the present constraints and realities
REGULATIONS & POLICIES	C14 3 - fighting and preventing pollution in surface and groundwaters C14 4 - ocean pollution: controlling chemical, human waste C14 5 - oceans pollution: controlling in particular the removal and generation of plastics waste C14 6 - controlling overfishing in oceans c14 11 - to pursue the prevention of underground soil pollution (fuel, etc.) c14 12 - to control mineral resources exploitation (extraction and uses) via regulations and policies	C 27 1 - to pursue the follow-up of international regulations & agreements regarding climate C27 2 - to pursue follow-up regulations limiting or eliminating atmospheric pollutants C27 3 - to pursue the regulation of phytosanitary (pesticides, nutrients, etc.) products and other pollutants uses C 27 4 - to adopt strict regulations abrogating economical, financial, and ecological predatory practices	C33 4 - to adopt strict regulations abrogating economical, financial, and ecological predatory practices	C42 1 - to redefine democratic and human right values at the light of the present constraints and realities
TRAINING	C11 2 - to educate about the sharing of qualitative values and its interest for collective economic endeavours C12 4 to educate about circular economy processes	nb. action C11 2 engages stakeholders.	C33 5 - to disseminate the adopted practices, train the relevant players to make them used, and provide financial incentives C31 1 - to develop relevant capacities and a relevant knowledge for enacting field players C31 2 - to develop operationally relevant integrated transition plans putting in practice the revised strategy of sustainable welfare development	

**Table 3.** Priority series of symbiotic actions to make a project really happen (example from the referenced *Systemic Reinterpretation of the European Green Deal* case [19,20]).

## 6. Discussion

It is important to underline that the direct learning of such a systemic methodology requires some method-centered features:

1. *The fundamental dimension of paradigmatic evolution* integrating - not opposing - a formal systemic dimension in project management methodologies practices should be made clear to parties;
2. The participants need *regular methodological guidance*, conceptual refreshing, and method re-centering, in order to avoid deviation from the systematic expansion search;
3. The method requires *poise and to stay firm on track*, while maintaining the expert motivation and stewardship always high;
4. The work should lead to *making implementation feasible* and leave room to *scalable realizations*. Results should be varied enough to offer a palette of priority options and the structure should be *directly readable* by the decision-makers;
5. *External checks and revisions of the process itself* are commendable. The possibility of securing an external reviewer at mid-point with interested and competent parties is to be contemplated.

Furthermore, one may note the number of situations in which poorly integrated dimensions in the operational management of the multidimensional interactions of issues at stake in many societal projects lead to immobility, if not failure. This is shown by the increasingly materialized crises represented by various present and emerging "pandemics", be they sanitary, climate, environmental, food, socio-economic and, perhaps soon, more and more political. See for example the relative "cacophony" in the management of the Corona-19 pandemic or in the delays to adopting and applying realistic strategies to manage climate issues commensurate with their challenges.

Often, a lack of structured and operational methodology to integrate the sometimes contradictory constraints imposed by crises predominates. It can be due to the too reductive dissociations found between the objectives, their stakes, their constraints, the possible solutions and the stakeholders who can be mandated to implement them. Cacophonies arise that unfortunately lead to growing the fragilities of our societal models. At the same rate, the latter are also made up of increasingly complex and irreducible interactions in the face of a growing societal complexity level and the lurking risks of multiple and varied crises.

Finally, the authors consider that present operational opportunities to integrate systemic dimensions can provide higher intelligence and lucidity levels in the management of the intrinsic complexity of the combined major world crises. By harmonizing the necessary actions in the face of combined sanitary and climate crisis, these opportunities positively contribute to reduce societal cacophonies.

## References

1. de Rosnay J., *The Macroscope*, Harper & Row, New York, 1979. (Out of print)  
[http://www.physicsoflife.pl/bibliografia/books/Rosnay\\_The\\_Macroscope.pdf](http://www.physicsoflife.pl/bibliografia/books/Rosnay_The_Macroscope.pdf)
2. Morin E., *Method: Towards a Study of Humankind.*, Volume 1 to 5. Vol 1: *The Nature of Nature* <https://www.bookdepository.com/Method-Edgar-Morin/9780820418780>
3. Watzlawick P. Helmick J. & Beavin-Jackson D., *Pragmatics of Human Communication*, Faber and Faber, 1968.

4. Le Moigne J.L., Agir – penser en complexité. Le discours de la méthode de notre temps, 2010. <http://www.intelligence-complexite.org/fileadmin/docs/1107-dossier27-2.pdf>
5. Ross D. A. and Wade J., A Definition of Systems Thinking: A Systems Approach. *Procedia Computer. Science* 44: 669-678, Dec. 2015.
6. Hester, P., Adams K., *Systemic Thinking Fundamentals for Understanding Problems and Messes*, Springer International, 2014.
7. ESIEE, *Le Management de Projet Systémique, 2007-2020*. Courses given as part of the ITMP (Technological Innovation and Project Management) Master's degree at <https://www.systemique.com/articles/systemique-a-luniversite/le-management-de-projet-systemique.html>
8. System Learning Institute, Switzerland *Outils Systémiques pour le Management de Projet*, 2020. <https://sli-sa.ch/wp-content/uploads/2018/05/Management-syst%C3%A9mique-des-projets.pdf>
9. Centre Socialiste d'Education permanente (CESEP, Belgium) *Proposition systémique pour l'éducation permanente*, 2020. <https://www.cesep.be/index.php/74-publications/analyses/pratiques-de-formation/367-proposition-systemique-pour-leducation-permanente>
10. Teneau G., *Collapsologie, la crise systémique*, Institut national des Hautes études de la Sécurité et de la Justice (INHESJ, France), 2020. <https://inhesj.fr/publications/lirec/collapsologie-et-crise-systemique>
11. Melese J., *Approche systémique des organisations*, Les Éditions d'Organisation, 1990, 1995. <http://www.cnam.fr/lipsor/dso/articles/fiche/melese.html>
12. Cao G., Clarke S. & Lehaney B., *The Need for a Systemic Approach to Change Management— A Case Study Systemic Practice and Action Research*, Vol. 17, pp. 103–126, 2004.
13. Gorod A., Hallo L., Nguyen T., *A Systemic Approach to Complex Project Management: Integration of Command-and-Control and Network Governance*, *Systems Research & Behavioural Science* 35-6, 811-837, Nov.-Dec. 2018.
14. Hatchuel, A., & Weil, B., *A New Approach of Innovative Design: An Introduction to C-K Theory*, *Int. Conf. on Engineering Design, ICED 03*, pp. 1–15, Stockholm, 2003.
15. Hatchuel A., Le Masson, P., Weil B., *C-K Theory in Practice: Lessons from Industrial Applications*, *International Design Conference, Dubrovnik*, 2004.
16. Hatchuel, A., & Weil, B., *C-K Design Theory: An Advanced Formulation*, *Research in Engineering Design*, 19(4), pp. 181–192, 2009.
17. Donnadiou G., & Karski M., *La systémique : penser et agir dans la complexité*, Ed. Liaisons, Rueil-Malmaison, France, 2002.
18. Plantec Q., Le Masson P., Weil B., *Impact of Knowledge Search Practices on the Originality of Inventions: A Study in the Oil & Gas Industry*, *Academy of Management Conference (AoM)*, Vancouver, Canada, Aug 2020.



19. Corsi, P. & de Gerlache, J., A Systemic Interpretation of the European Union Green Deal, Club of Rome EU Chapter, 2<sup>nd</sup> June 2020. <https://www.clubofrome.eu/a-systemic-interpretation-of-the>
20. de Gerlache J., Une interprétation systémique du Pacte Vert pour l'Europe, Club of Rome EU Chapter, Sept. 16 2020. [https://www.clubofrome.eu/une-interpretation-systemique-du?var\\_mode=calcul](https://www.clubofrome.eu/une-interpretation-systemique-du?var_mode=calcul) & Up'Magazine, Sept 15, 2020. <https://up-magazine.info/decryptages/analyses/66353-green-deal-une-interpretation-systemique-pour-leurope/>
21. de Gerlache J., Mettre en œuvre les transitions énergétiques - Stratégie intégrative et gestion opérationnelle, Dunod, Paris, 2019. <https://www.dunod.com/sciences-techniques/mettre-en-oeuvre-transitions-energetiques-strategie-integrative-et-gestion>
22. de Gerlache J. & Coërs P. (main authors), Towards Sustainable Development 2008-2012, Solvay Sustainability Report, 2008. [http://www.sustainabilityreports.be/sites/default/files/reports/solvay\\_sr\\_2008-2012\\_en.pdf](http://www.sustainabilityreports.be/sites/default/files/reports/solvay_sr_2008-2012_en.pdf)

## Acknowledgments

The authors thank the *Club of Rome – EU Chapter* for promoting this work through its website.



© 2020 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution license *Creative Commons Attribution* (CC BY) (<http://creativecommons.org/licenses/by/4.0/>)